# Automation of business processes of the logistics company in the implementation of the IoT

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**Abstract.** It is known that the maintenance of vehicles is one of the main tasks of the transport company. The article analyzes the activities of the company engaged in railway transportation. The company is one of the largest oil carriers in the former Soviet Union. The main attention was paid to the analysis of the process of control of the technical condition of components that was carried out in EPC notation. Due to the lack of automated diagnostics of parts, the company spends time stopping vehicles to check the technical condition, which leads to financial losses. After analysing the market opportunities, it was decided to use an automated system that includes the Internet of Things technologies. Based on the capabilities of the system, the process of monitoring the technical condition of components "as it should be" was built. The new algorithm helps to avoid unwanted downtime, as well as reduces the repair time of components due to automatically generated reports on the technical condition.

**Keywords:** IoT in transport company, business processes automation.

## 1. Introduction

Rail transportation is widespread as it provides fast delivery over long distances. The main advantage of this type of transportation is the low cost. However, the activities of the company engaged in rail freight associated with high financial and labor costs to maintain the rolling stock in working order.

The object of the study is the company " BaltTransService ". BaltTransService is one of the largest private operators specializing in rail transportation of oil cargo in Russia, CIS, and Baltic countries.

Modern companies strive to reduce time and financial costs by automating processes [1]. The introduction of automated information solutions based on modern information technologies is an extremely expensive and time-consuming process, forcing the company to mobilize financial, human and material resources.

The subject of the work is the automation of control of the technical condition of parts and components. There are many solutions on the market to ensure regular maintenance and repair, as well as to keep records of available parts, their quality, and quantity. Systems of this class include EAM-systems (Enterprise Asset Management System), which allow you to automate a set of tasks to maintain the state of equipment in the organization. Also, modern technologies such as the

Internet of Things allow to minimize human participation in the diagnosis of the condition of vehicles allowing us to automate this process.

The work aims to analyze the process of monitoring the technical condition of parts and components. This work seeks to solve such problems as the analysis of the company's activities, the analysis of the possibilities of modern technologies, which are made to simulate the process of monitoring the technical condition of vehicles "to be".

The paper presents three main sections. In the first section, the analysis of the activity of the firm is made, the description of business processes with identification of weaknesses of the company is made. Processes are described in EPC notation, which is an ordered combination of events and functions. The notation describes lower-level decomposition processes. The second section presents the capabilities of the company's assets management system, EAM-system, which serves as the basis for further implementation of IoT technologies. [2] The third section describes in detail the possibilities of the IoT technologies in the field of control over the technical condition of vehicles. transportation is widespread as it provides fast delivery over long distances. The main advantage of this type of transportation is the low cost. However, the activities of the company engaged in rail freight associated with high financial and labor costs to maintain the rolling stock in working order.

## 2. Methods

This section analyzes the activities of the company and the process of monitoring the technical condition of components.

Based on the diagram constructed in the EPC notation we identified weaknesses in the activities of the enterprise, which was the impetus for the analysis of existing solutions to these problems. Such solutions are automated systems that include the Internet of Things technologies.

Analysis of the capabilities of these technologies allowed to predict changes in the process of monitoring the technical condition of components after automation.

*2.1 Analysis of the performance of the company.* LLC BaltTransServis (BTS) was launched in 1999 in St. Petersburg.

BaltTransService is one of the largest private operators specializing in rail transportation of oil in Russia and Baltic countries.

The company has representative offices in Moscow, Ryazan, Yaroslavl, Voronezh, Samara, Velikiye Luki and Dno, its own wagon repair depot in Ivanovo, as well as a subsidiary of locomotive repair LLC "Remtransservis" in Rybinsk.

BaltTransService is a member of Globaltrans group – one of the leaders of the rail freight market in Russia, the CIS and the Baltic States. As of the end of 2016, the total rolling stock of Globaltrans group consisted of about 68.5 thousand units. The basis of the fleet consists of universal gondola cars and tank cars. Among Globaltrans ' key clients are large Russian industrial groups in the metals and mining industries, as well as in the oil and oil products sector.

Since the company owns many wagons and locomotives, the complex and significant problem is to monitor the performance of parts and components. [3]

The organization has processes that can be defined, measured and improved. These processes interact to achieve results that are consistent with the goals of the organization and cross-functional boundaries. [4] Some processes may be important, and others may not. The actions that make up the process's preform inputs to outputs. Process modeling is widely used within organizations as a method to increase awareness and knowledge of business processes and to deconstruct organizational complexity. [5] Accordingly, process models are considered a key instrument for the analysis and design of process-aware Information Systems. [6]

The process of technical conditional controlling was analyzed in order to identify problems and to improve performance of the company. The weak spots of the process lead to money losses because of cooperation with unreliable suppliers and unexpected breakdowns (illustrated in figure 1). The process modeling was performed in EPC notation. The EPC has been developed within the

framework of the Architecture of Integrated Information System (ARIS) and is used by many companies for modelling, analyzing, and redesigning business processes. [7]

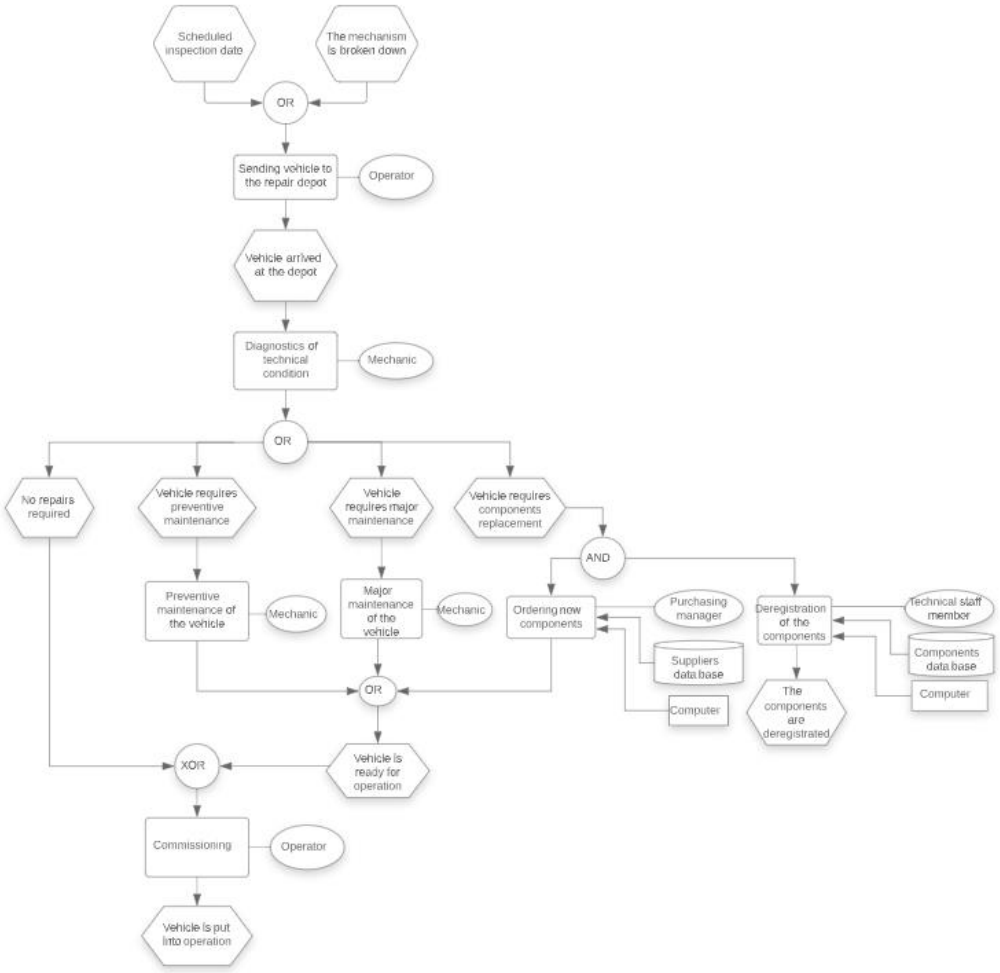


**Figure 1.** The process of technical condition controlling “as is”.

Damage inspection is carried out by a mechanic who analyzes the possibility of repair or confirms the need to purchase a new component.

The analysis of components requires time, which leads to temporary capacity reduction.

The disadvantage of this process model is that the vehicles are sent to the depot even though they don’t have any technical issues. Automated diagnostics could prevent such a capacity loss.

*2.2 EAM-systems.* Turnkey solution is EAM-system (Enterprise Asset Management System). This system is designed for the management of fixed assets, namely, automation of accounting processes, maintenance and repair of fixed assets. This class of systems is widely spread among transport companies, as they provide quality management of physical assets and their modes of operation, risks and costs during the asset life cycle in order to implement the strategic plans of the organization. EAM allows to reduce the downtime of assets, reduces the cost of maintenance and logistics. The system enables to manage such processes as maintenance and repair, logistics, inventory management. Nowadays this class of systems provides customers with modern technologies such as the IoT. The cooperation of smart sensors and the EAM analytics makes asset management as efficient as it is possible now.

*2.3 The Internet of Things.* Nowadays, many leading companies tend to use modern technology to expand their capabilities and achieve better results. One of such a technology which is recognized as one of the most important areas of future technology [8] is the information exchange approach which is known as IoT, which is often referred to as the techniques, technologies, systems, practices, methodologies, and applications that analyze critical business data to help an enterprise better understand it's business and market and make timely business decisions. [9,10] The IoT was first proposed in 1999 [11, 12] as a connectivity method between the physical world and the cyber one. [13] IOT usage become possible after implementation of Cloud Computing and RFID. [14,15] Basically, IOT is real-time processing of Radio Frequency Identification readings for events handling [16]. As part of the tasks of accounting the parts and components condition, IOT technologies can allow companies to achieve high accuracy and informative reports and statistics, while minimizing the human factor. The transition to full automation of data collection through the introduction of reading sensors and the programs for the analysis of this information can lead to a lot of opportunities, unattainable for the company at this stage. [17]

IOT technologies can be used for data collection and subsequent analysis in the EAM system. IOT technology is used to create a network of autonomous, Internet-connected and information-sharing sensors. The main idea is to equip all technically important parts with sensors in order to create a constant data flow, its accumulation and subsequent analysis. [18] The analysis of the accumulated big data allows to objectively assess non-obvious correlations and trends, allowing management to make more aware decisions. [19]

The widespread use of IOT sensors on rolling stock parts can help the company not only to identify suppliers of defective equipment, weaknesses of the equipment, but also to predict breakdowns, schedule repairs and offer long-term planning with high accuracy. Historically, many companies repair only after a breakdown has already occurred, but big data analysis can help you calculate the correct frequency of preventive maintenance to maximize the life of your equipment. [20]

The consequences of the implementation and usage of IOT technologies and big data analysis can become a complete change in the interaction of physical assets of the enterprise requiring maintenance with employees planning and performing such repairs. [21] Parts and equipment can declare their "needs", as well as" advise " repair teams repair tactics to minimize the risk of damage.

To provide a complete analysis of the parts and components condition, the following IOT features are used:

- GPS tracking devices. Small Autonomous devices can constantly transmit information about the location of each car or locomotive.
- Wheelset diagnosis sensors. The sensors installed on the wheelset help to analyze important parameters, for example-the level of vibration, and their nature, often signaling a specific failure or breakdown.
- Brake condition monitoring devices. Help to control the most important technic condition indicators such as temperature, vibration and pressure.
- Connectivity hardware - the type of hardware that provides the integration and data flow with main database.
- Specific sensors on the electronic devices of the locomotive - several sensors that gain information from the electronical and technical equipment of the locomotive.

## 3. Results and Discussion

The “to be” process was built according to the research (illustrated on figure 2). IoT technologies let transport company automate the diagnostics process which changes an operation chain.

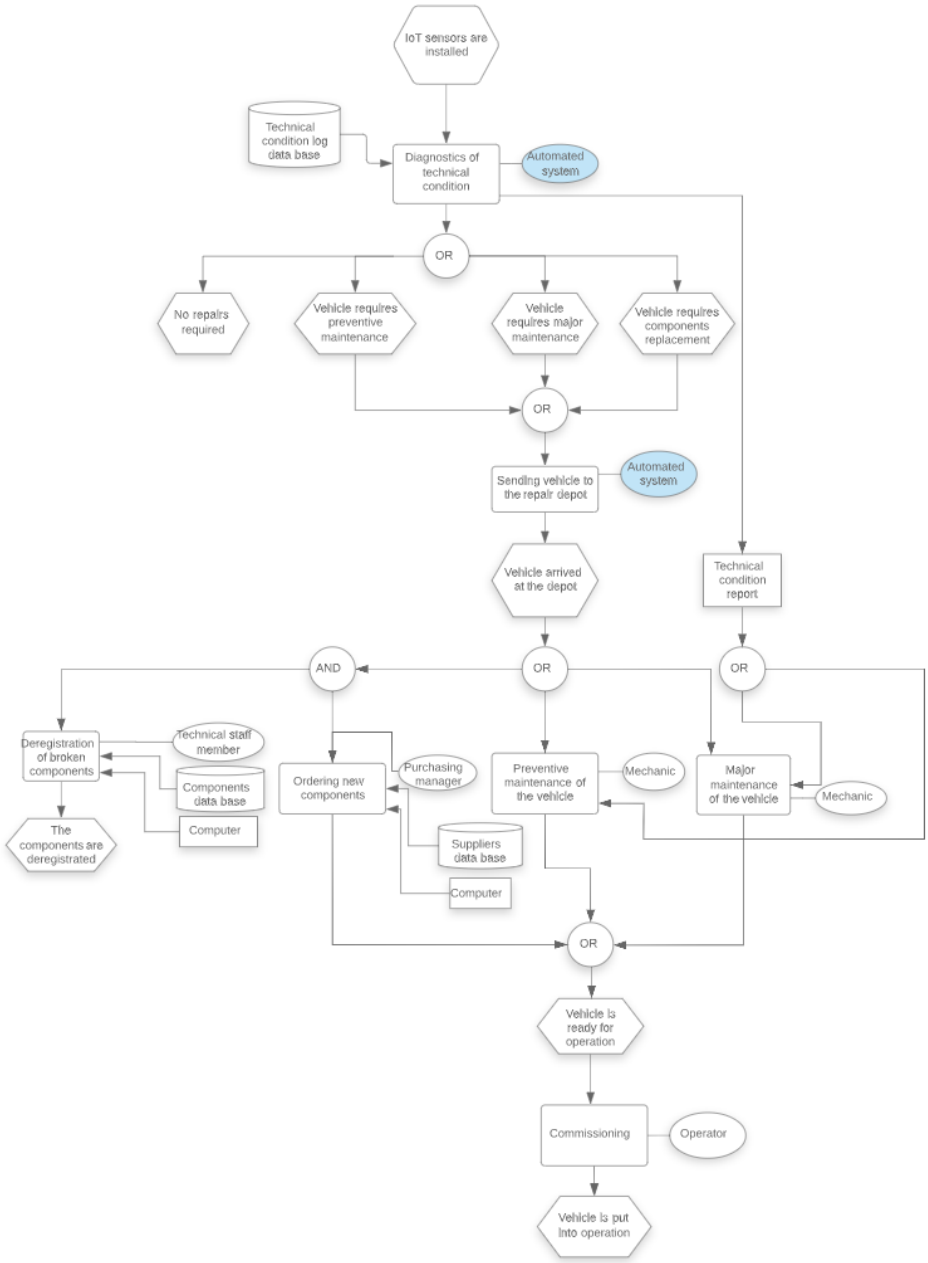


**Figure 2.** The process of technical condition controlling “to be”.

The results that might be gathered from the use of above-mentioned technologies.

- IOT sensors can help maintain the security measures required for specific loads or track sections. [22] Operational analysis of key safety indicators can help the company and the locomotive team to avoid accidents, damage to cargo or equipment. [23] It also eliminates the risk of vandalism, theft and replacement of working components with used or defective ones.
- At any time, it is possible to analyze the current geographical location of any rolling stock car, to correlate the nature of breakdowns with the directions of movement, specific regions and repair depots. The ability to analyze the patterns of technical breakdowns and mechanical damage allows you to change the route planning and technical equipment of rolling stock, depending on the regions of the route. [24] Also, subsequently, it is possible

to interact with IOT systems of other services for the purpose of more competent route planning. [25]

- Savings on repairs. Companies that actively use IOT in the EAM sphere have developed a tactic called Optimal maintenance to delay the planned repair of components as much as possible, which does not lead to damage. Postponement allows you to reduce the number of planned repairs in the life cycle of the part, opening the possibility for conscious savings. [26, 27]
- Training of repair crew. Increased specification of the analysis of breakdowns and their causes allows to find out weak points of technologies and to focus attention of repair crew on the most important aspects. [28]
- Train the drivers. Analyzing the driver's habits and establishing patterns between those driving habits and rolling stock breakdowns will allow some changers in the approach to training. [29]

## 4. Conclusions

This paper illustrates the changes in business processes before and after the introduction of an automated system using the IoT technology in the company engaged in rail freight. This goal was achieved by analyzing the company's activities, finding its weaknesses and compensating solutions.

The main process considered in the article is the control of the technical condition of components. The efficiency of this process directly affects the quality and speed of service delivery, so its low automation leads to money and time losses. Thanks to modern technological capabilities, diagnostics of the state of technical means can be carried out without the participation of human resources.

EAM systems in cooperation with the IoT make it possible not only to receive timely information about breakdowns but also to avoid excessive inspections of vehicles. Furthermore, the analytical capacity of the EAM system can perform additional data analysis, leading to improvements in other processes within vehicle maintenance.

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